# UNIVERSITY OF THE WITWATERSRAND

FACULTY OF HEALTH SCIENCES

SCHOOL OF PUBLIC HEALTH

## RESEARCH REPORT

# TITLE: The impact of migration on adult mortality in rural South Africa: Do people migrate into rural areas to die?

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Research report submitted to the Faculty of Health Sciences, University of the Witwatersrand, Johannesburg in partial fulfillment of the requirements for the Degree of Master of Science in Medicine in the field of Population Based Field Epidemiology.

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**DECLARATION**

I, Paul Welaga declare that this research report work is my own work. It is being submitted for the degree of Master of Science in Medicine in the field of Population Based Field Epidemiology in the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination at this or any other University.

Signature: _____

Full Name: Paul Welaga

_____ day of June 2006

**Dedication:**

This work is dedicated to my lovely mother, Agnes Welaga, for her support and encouragement to me during my studies and for always being a mother.

Abstract:

**Objective**

This work investigates the hypothesis that individuals recently migrating into rural areas have a higher mortality than those always resident and that migrant deaths are more likely to be HIV/AIDS related than non migrant deaths.

**Methods**

Data from the Africa Centre Demographic Surveillance System (ACDIS), South Africa, was used for the analysis. A total of 41519 adults aged 18 to 60 years since their last visit dates were categorized into three groups; internal migrants, external in migrants and always resident individuals since 2001. Follow up period was from 1st January 2001 to 31st December 2005.

Cox proportional hazard regression method was used to quantify the additional risk of dying for migrants who have recently migrated into the DSS area. Logistic regression was used to examine the relationship between migration status and dying from AIDS related complications for the members in the sample whose cause of death have been identified using verbal autopsy procedures.

**Results**

External in migrants into the DSS area were 1.52 times more likely to die than those always resident. After adjusting for the effects of sex, age group, socio-economic status and educational level an external in migrant has a relative risk of 1.19, [adjusted HR=1.19, P=0.001, 95% CI (1.08,1.32)] of dying compared to those always resident. Internal migrants were 18% less likely to die compared to always resident individuals, [adjusted HR=0.82, P=0.008, 95% CI (0.71, 0.95)] and males were 1.38 times more likely to die within the follow

up period compared to females, [HR=1.38, P<0.001, 95% CI (1.28, 1.49)]. These results were statistically significant at 95% confidence level.

Out of a total of 1119 deaths that occurred in 2001 and 2002 whose cause of death have been identified through verbal autopsy procedures, 763 (66%) died of AIDS. The odds of dying from AIDS are 2.09 if you are an external in migrant compared to an always resident member, [unadjusted OR = 2.09, P = 0.009 95% CI (1.38, 3.16)]. After controlling for other factors in the model, the odds of dying from AIDS as an external immigrant was 1.79 times, [adjusted OR = 1.79, P = 0.009, 95% CI (1.15, 2.77)] compared to those always resident. There was no significant difference in AIDS mortality between always resident individuals and internal migrants. The odds of a female dying of AIDS was 2.33 times, [OR = 2.33, P<0.001, 95% CI (1.78, 3.06)] compared to males after controlling for migration status, age, socioeconomic status and educational level.

**Conclusion**

External in migrants have an increased risk of death among adults aged 18 to 60 years compared to those always resident. External in migrants are also more at risk of dying from AIDS related illnesses than those always resident. Internal migrants are less likely to die than those always resident. Females are more at risk of dying from AIDS than males. In resource-poor settings, especially in many parts of Africa and other developing countries with very high prevalence of HIV/AIDS and over burdened health services in rural areas, it is important to identify and quantify some of these trends contributing to high disease burdens and mortality in rural areas in order to put in place effective interventions to better the health conditions of the people in these areas.

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## DEFINITION OF TERMS

1. Verbal autopsy: A tool used to determine probable cause of death in areas lacking a vital registration system. (K. Kahn et al, 2000)

2. Demographic Surveillance System: This is a set of field and computing operations to handle the longitudinal follow-up of well-defined entities or primary subjects (individuals, households, and residential units) and all related demographic and health outcomes within a clearly circumscribed geographic area (INDEPTH Network).

3. Internal migrant: An individual who moves from one homestead to another within the demographic surveillance area.

4. External migrants: People who moved from places outside the demographic surveillance area into residency in surveillance area.

5. Always resident members: These are individuals who are always resident in the demographic surveillance area.

6. Homestead: a bounded structure used for residential purposes only.

7. Household: This is a social group of one or more individual members. They are usually but not always related.

## ABBREVIATIONS AND ACRONYMS

| | |
|---|---|
| DSS | Demographic Surveillance System |
| DSA | Demographic Surveillance Area |
| ACIDS | Africa Centre Demographic and Information System |
| AIDS | Acquired Immune Deficiency Syndrome |
| VA | Verbal autopsy |
| ASSA | Actuarial Society of South Africa |
| HIV | Human immuno-defiency virus |
| UNAIDS | The Joint United Nations Programme on HIV/AIDS |
| WHO | World Health Organization |
| DSA | Demographic Surveillance Area |
| UNFPA | United Nations on Population Fund |
| INDEPTH | International Network for Continuous Demographic Evaluation of Populations and Their impact on Health in Developing Countries |
| PWA | People with AIDS |

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# Chapter One: Literature Review

## 1.1 Introduction

In many developing countries, especially in Southern Africa, HIV/AIDS is the leading public health burden. South Africa has witnessed a rapid growth in the spread of HIV in the decade of the 1990s and AIDS is now the leading cause of death in South Africa[1]. There are still no signs of a breakthrough in the fight against HIV/AIDS. This epidemic affects all parts of the population, though women are more likely to be infected than men. Many tens of thousands of people are dying and many studies have shown that AIDS is currently the leading cause of death in many southern Africa countries including South Africa[1,2].

South Africa has also experienced and is still experiencing a very high rate of population movement. Circular migration where people migrate into urban areas primarily to look for jobs whilst maintaining a link with their homes in the rural areas is still part of their normal lives. Studies on the impact of migration on HIV prevalence have shown that migrants are more at risk of contracting HIV and other sexual transmitted diseases than non migrants. AIDS is also having a devastating effect on the productive youth who often migrate to urban areas in search of greener pastures. When these migrants are infected with the HIV virus and subsequently develop AIDS, and have no hope of survival, may go back to where they migrated from, mostly rural areas, for treatment and possibly to die. When this unfortunate situation occurs, it puts more stress and burden on the already poor rural residents and also has some implications on the limited health facilities and services in the rural areas. This could have important implications for future health policy and planning with the aim of improving access to health and social services in the rural areas.

Studies on migration often ignore the impact of returning migrants to their rural communities and the health and social implications it may have in the rural areas.

Policy makers and researchers often focus their attention on the detrimental effects of migration on urban health and social services such as the provision of good quality drinking water, medical facilities and good roads to meet the demands of the urban population. Little attention has been given to the impact of returning migrants to their rural communities and the health and social consequences this may have on health services there. Many studies on migrant labour look at migrant labourers at their place of work; few explore the health effects of their return to rural areas[3]. Also only a handful of studies have attempted to examine the potential links between AIDS and return migration.

The main objective of the study was to investigate the hypothesis that individuals migrating into rural areas have a higher mortality than those always resident. The study also tested the hypothesis that migrant deaths are more likely to be HIV/AIDS related than non migrant deaths. Finally, the study attempted to describe the causes of death for migrants and non migrants.

**1.2 Migration in South Africa**

South Africa has a very high level of circular migration[3,4,5]. Migration in South Africa, and indeed the whole of Africa does not mean permanent removal from one's place of origin. Many people, particularly those in rural areas do migrate into urban areas to work whilst maintaining a link with their rural households of origin[3, 6]. Until they return, migrants maintain a close contact with their homes, often in rural areas, through regular visits[6]. A study on the prevalence of circular migration in Agincourt showed that the majority of circular migrants (58–67%) had communicated with their family back home in the two weeks prior to the interview. More than four out of five circular migrants had been in communication with their family within the last three months and less than 20 percent had not been in contact for at least six months[7].Migration patterns in South Africa did not simply arise out of chance. They are as a result of decades of

legislation aimed at restricting the movements of the majority of the population and providing a steady flow of cheap black labour to the gold mines and other industries[3]. Even though the apartheid system has ended, there is no evidence in South Africa to support the assumption that circular labour migration 'ended' or even declined. On the contrary, temporary labour migration within the country appears to have increased, driven particularly by the rise in female labour migration[8]. With the lifting of formal restrictions on African urbanisation within South Africa in the late 1980s, there would be an increased possibility for families rather than individuals to migrate, and the expectation that circular or temporary migration within South Africa would be replaced by the permanent settlement of people at places of employment[8]. However, the evidence available does not suggest that temporary labour migration in the country is being replaced by the permanent settlement of people at places of employment. On the contrary, between 1993 and 1999, the number of labour migrants who are reported as retaining membership in and economic ties with their households of origin within South Africa increased[8].

There are a number of possible reasons why people continue to migrate 'temporarily' within South Africa, retaining membership in, and ties with, their households of origin. In an environment of increasing labour market insecurity and rising unemployment, for example, the household of origin may provide 'insurance' for work-seekers, care of children, and a preferred place for retirement[7]. The household in the village could also serve as a place to seek comfort with household members when seriously sick and possibly to die.

### 1.3 Migration and HIV/AIDS

Studies have shown that there is an association between migration and the spread of HIV and migrants are particularly susceptible to HIV both in Southern Africa and outside[3,9,10,13]. Today migration has become a central theme in the discussion of AIDS[9]. Decosas and Adrien argue that

the link between migration and the spread of HIV is not dependent on the origin of the migrant but the "conditions of life during the voyage and at the site of destination"[10]. The largely seasonal or temporary character of migration in southern Africa, with migrants returning home to their families on a regular basis has contributed significantly to the spread of HIV in the Southern Africa Region[11]. A study carried out in Kwazulu-Natal shows that people who have recently migrated or changed their places of residence were three times more likely to be infected with HIV than those resident[12]. The reason for this difference in risk is that migrants are more likely to have another partner at their new destinations and also engage in unsafe sex[4]. Migrants' vulnerability to HIV/AIDS was summed up by Lurie as quoted, "If one were to design a social experiment in an attempt to create the conditions conducive to the spread of HIV and other sexually transmitted diseases, you would remove several hundred thousand rural men from their families, house them in single-sex hostels, provide them with cheap alcohol and easy access to commercial sex workers and allow them to return home periodically. These conditions roughly describe the situation for more than eight hundred thousand gold miners and countless other migrant labourers working throughout South Africa today"[3]. However, the direction of spread of the HIV epidemic is not only from returning migrants to their rural partners as research has shown that women's sexual networks extend beyond their regular partners and these networks influence HIV transmission within rural areas[3]. A study on HIV-1 concordance and discordance among migrant and non-migrant couples in South Africa found that the direction of spread is not only from returning migrant men to their rural partners, but also from women to their migrant partners[13]. Another study on male rural urban migration in Tanzania and its interaction with sexual behaviour found that both married and unmarried rural urban migrants were not having sex in town and that the migrant population studied regulated its behaviour in a way that reflected local understandings of the AIDS disease[14].

Migrants sometimes may be forced to move to their homes because of their advanced state of illness and need to be cared for by those close to them. Research in Thailand revealed that the most common place for adult persons living with AIDS (PLWAs) to spend the terminal stage of the illness is in the parental home and the most common caregiver at this stage is a parent, particularly a mother[15]. "Moreover, the virtual certainty of death, at least for most of the infected living in developing countries, and the potential stigmatization associated with the disease are likely to lead PWAs to seek an emotionally supportive environment in which to live after their symptoms become obvious to themselves and others"[15].

### 1.4 HIV/AIDS in South Africa and Sub-Saharan Africa

Sub-Saharan Africa has just over 10% of the world's population, but is home to more than 60% of all people living with HIV—25.8 million [23.8 million–28.9 million] [16]. In 2005, an estimated 3.2 million [2.8 million–3.9 million] people in the region became newly infected. Among young people aged 15–24 years, an estimated 4.6% [4.2–5.5%] of women and 1.7% [1.3–2.2%] of men were living with HIV in 2005[16]. Southern Africa is the epicentre of the global HIV/AIDS epidemic. In some southern African countries more than one in three adults is currently living with HIV/AIDS. Countries like Lesotho, Botswana, South Africa, Swaziland and Zimbabwe have the highest HIV prevalence rates in the world[11]. South Africa is experiencing an HIV/AIDS epidemic of shattering dimensions. In South Africa, approximately 29.5% of women attending antenatal clinics were HIV-positive in 2004[17]. Prevalence was highest among women aged 25–34 years - more than one in three of whom was estimated to be living with HIV. Among women aged 20–24 years, almost one in three was infected. In the country's worst-affected province, KwaZulu-Natal, prevalence has reached 40%, while it has remained exceptionally high at between 27% and 31% in the Eastern Cape, Free State, Gauteng, Mpumalanga and North West provinces[18].

Population Based Voluntary Counseling and Testing for HIV carried out in Africa Centre DSS among women aged 15 to 49 years and men 15 to 54 in Kwazulu-Natal province had an estimated prevalence of HIV of 23% in 2004[19]. In 2005, the overall HIV infection rate was not different. The prevalence rate for both men and women aged 30 years and above was over 30%[19].

### 1.5 AIDS Mortality

According to the 2005 UNAIDS report, an estimated 3.1 million adults and children died of AIDS in the world and in Sub-Saharan Africa alone, 2.4 million adults and children died of AIDS in 2005. South Africa is currently experiencing one of the most severe HIV epidemics in the world. By the end of 2003, there were around 5.3 million people living with HIV in South Africa. UNAIDS estimates that 370000 lives were claimed by AIDS in 2003 and more than 1,000 AIDS deaths are occurring every day.[18]. According to the Actuarial Society of South Africa (ASSA2002 model), about 311,000 people died from AIDS in 2004 - comprising 44% of all deaths. Among adults aged 15-49 years, it estimates that 70% of all deaths were due to AIDS[20]. Out of the deaths that occurred in 2000 for people aged 15 to 45 years in Africa Centre DSS, about 48% of them were AIDS related deaths[21]. According to the South Africa AIDS mortality report released by the Medical Research Council of South Africa, approximately 40% of adult deaths aged 15-49 and about 20% of all adult deaths in the year 2000 were due to HIV/AIDS[22].

### 1.6 Mortality in urban and rural areas

There is conflicting evidence about mortality differentials between rural and urban areas. Research in Latin America has shown that migrants tend to suffer higher rates of mortality and morbidity, at least initially, than long-term urban residents[23]. Gwendonlyn argues that until the close of the 19$^{th}$ century, mortality levels were much higher in urban cities than in rural localities of European countries and United Sates and added that these days mortality is no longer uniformly

higher in urban cities than in rural communities of economically developed countries[24]. A research conducted in Egypt showed that differences in mortality rates between rural and urban areas were apparent, with the rates in rural areas being higher than the urban areas[25]. In Mozambique, the death rate for urban areas was about 14.3 per 1000 compared to 24 per 1000 for rural areas in 1997[26]. Contrary to these findings, in the United States it was found that persons living in the most rural localities and those living in rural communities in standard metropolitan statistical areas have the lowest risk of mortality, while those living in central cities had the highest risk of dying, but however pointed out that the protective effect of rural residence declines in older age cohorts[27]. A longitudinal study in Britain showed that selective migration over the whole life-course at the local level does appear to have significantly altered the geographical pattern of mortality seen in Britain[28]. In many of these studies, migration has not been considered as a contributing factor that could influence the mortality difference between rural and urban areas.

### 1.7 Research Question

There is no doubt that AIDS is having a devastating effect on the health of many people in South Africa and indeed the whole world. There is overwhelming evidence that AIDS is the leading cause of death in South Africa, and migrants are particularly at risk of contracting this disease. Not much research has been conducted to find out about the impact of returning migrants to their rural homes. The South Africa AIDS mortality report's projections show that, "without treatment to prevent AIDS, the number of AIDS deaths can be expected to grow, within the next ten years, to more than double the number of deaths due to all other causes, resulting in 5 to 7 million cumulative AIDS deaths in South Africa by 2010[22]. Looking at the fatal nature of AIDS and the resources, efforts and time required to care for fatally ill AIDS patients and the fact that migrants are more likely to acquire this disease, it is important to find out whether returning migrants contribute to the mortality levels being experienced in rural areas.

### 1.8 Hypothesis

- Individuals migrating into rural areas have a higher mortality than those always resident
- Migrants are more likely to die from AIDS compared to non-migrants.

### 1.9 **Aim**

The aim of this study is to find out whether returning migrants have a higher mortality level than those always resident in rural areas to determine whether migrant deaths are more likely to be AIDS related than non migrant deaths and to suggest possible intervention strategies to improve the quality of life of rural dwellers.

### 1.10 Specific Objectives

**Primary objective**

To compare mortality rates between migrants and non-migrants aged 18 to 60 years in Africa Centre DSS, Kwazulu-Natal, South Africa

**Secondary objectives**

- To compare cause specific death rates due to AIDS for migrants and non-migrants 18 to 60 years in African Centre DSS.
- To describe and compare the causes of death between migrants and non-migrants.

## Chapter Two: Methodology

### 2.1 Study Design

The study design was a cohort study and involved all individuals aged 18 to 60 years at the last visit date of the fieldworker, who were resident members of households in the Africa Center Demographic Information System, South Africa. For the survival analysis, all individuals aged 18 to 60 years who were resident members of homesteads in the DSS area from 1st January 2001 to 31st December 2005 were include in the cohort. Follow up period was from 1st January 2001 to 31st December 2005. The individuals in this cohort were further divided into three categories based on their migration history. All those who were resident in the Demographic Surveillance Area (DSA) on 1st January 2001 and remained resident till they either died or were censored at the last visit date of the fieldworker in 2005 were classified as always resident individuals. Those who migrated from outside the Demographic Surveillance Area into the study area after 1st January 2001 were classified as external in migrants. Those who have migrated within the study area i.e. movement of individuals from one homestead to another within the surveillance area after 1st January 2001 were considered as internal migrants. The deaths from all these three categories were recorded during the follow up period. The date they migrated into the DSA or started their individual residence in the area and the date of death for those who died were recorded. For those who moved out of the DSA, they were censored using the date they moved out, and for those who were still alive in 2005, their end dates were censored using the last visit date of the fieldworker. The number of deaths was recorded as well as the person time contribution of each of these groups was calculated. Data on socioeconomic status of the individuals using household assets as an index, sex, highest educational level achieved were also collected.

Verbal autopsies were conducted on the deaths which occurred in 2001 and 2002 to identify cause of death. The deaths were also classified into three groups – always resident individuals, internal migrants and external in migrants.

## 2.2 Study population and area

The Africa Centre Demographic Information Systems (ACDIS) is a longitudinal Demographic Surveillance System (DSS), which is situated in the municipalities of Hlabisa and Mtubatuba, in the Umkhanyakude District of Northern Kwazulu Natal, South Africa (see Appendix 1). The ACDIS maps 10,000 inhabited homesteads in a 435 square kilometre area, following 12,000 households with a total population of about 90 000 people. Information on births, deaths (including cause of death), migrations (in and out-migrations), family compositions, conjugal relationships, pregnancies, parental status are collected on residents as well as non-residents who retain membership of households in the demographic surveillance area (DSA) and saved in a temporal relational database. This information is updated six monthly. Data on household economic circumstances such as employment, assets, education, water and sanitation, etc as well as health are monitored, and key social and health changes were examined. The DSS site also carries out HIV serosurveillance of all resident men age 15-54, all resident women age 15-49, as well as 12.5% of non-residents of these ages. Health services include a district hospital and a network of 12 clinics. There is a high prevalence of HIV in the area, and a large proportion of the deaths in the area currently could be attributed to AIDS. Approximately 35% of the female household members and 40% of males 18 years and above are not resident in the area. This is an indication of a high rate of circular migration among the adults in the area.

The characteristics of the area, as well as the availability of quality data on migration and HIV/AIDS makes the area an ideal place to carry out this type of study.

### 2.3 Study Sample

The study sample involved all adults aged 18 to 60 years who were resident members of homesteads between 1st January 2001 and 31st December 2005 in the Demographic Surveillance Area (DSA) of the Africa Centre Demographic and Information System (ACDIS). In all, 41519 adults were part of the cohort yielding a total of 117012 person years and 2586 deaths. For the cause of death analysis, a total of 1119 deaths that occurred in 2000 and 2001, whose cause of death were identified through verbal autopsy procedures were included.

### 2.4 Data

Data for the analysis was obtained from the Africa Centre's Demographic Information Systems (ACDIS), South Africa. Data on the cause of death was based on the verbal autopsy data of the DSS site. In African Centre DSS, data is collected on births, deaths, in migration, out-migration, family compositions, conjugal relationships, pregnancies, parental status of all residents and non-residents who retain membership of households in the demographic surveillance area (DSA). A team of trained fieldworkers move from household to household to collect this information. Also, a team of field supervisors carry out quality control checks visits on a random sample of these households. Each household in the surveillance area is visited twice in a year and on each visit, the demographic information of the household is updated. The data collection instrument used was structured and unstructured questionnaires and trained fieldworkers who were fluent in the local language (Zulu) administered the questionnaires. There is also a tracking team of fieldworkers who ensure that people moving within the DSS are reconciled with their records already captured into the database to avoid duplication of individuals moving within the study area.

### 2.5 Household assets

The following assets were counted in households: bed net, bed, bicycle, block-maker, car, car battery, electric stove with oven, electric hot plate, electric kettle, fridge/freezer, gas cooker, lorry/tractor, motorcycle/scooter, radio, sofa/sofa set, sewing machine, table/chair, telephone, cell-phone, television set, video cassette recorder and wheelbarrow. The mean number of assets in a household in the area was seven. Those with less than seven household assets were categorized into one group and the ones with seven or more assets were put into another category. Those with missing values were also given another category.

### 2.6 Verbal Autopsy data

The verbal autopsy data collection process is based on information contained in an open-ended and structured standard questionnaire being administered by a trained fieldworker describing the symptoms and signs of illness of the deceased prior to his or her death. The fieldworkers who are trained nurses collect this information from a close relative or caretaker of the decease during the time of disease. Two clinicians with some experience in Africa, independently ascribe the cause of death using the information collected in the verbal autopsy and their clinical judgement. If there is disagreement about the cause of death, a third physician reviews the case. When this diagnosis agrees with one of the others, it is accepted as the probable cause of death [5].

### 2.7. Data Management

The data extraction, cleaning and merging of tables were done using Microsoft Structured Query Language (SQL). The variables for this research were selected from five different tables. The migration status, the date of migration (both in migration and out-migration) and date of death for those who died were obtained from the residency table which stores the residency episodes of all resident individuals in the Demographic surveillance area. The date of birth was obtained from the

individual table which contains the personal information about the individual. The educational status and number of assets were each stored in separate tables. All these tables were linked together and the required variables selected through an internal individual ID which is unique to every individual in the database. The ages were then calculated using the date of birth and the date of visit of the field worker. All those who ended their residency episodes before they started, i.e. those who either died or migrated out before they were migrated in were dropped from the analysis. When this data was cleaned, all those who died between 1st January 2001 and 31st December 2002 were merged with the cause of death table using the internal individual Ids of the members. Blank records were coded as "missing" and given a category during the analysis. The cleaned data was then saved as a text file and transported into STATA 8.0 using the stata command "insheet" for the analysis.

**2.8 Data Analysis**

The analysis was in two parts. Cox proportional hazard regression technique was used to quantify the risk of dying for migrants compared to always resident individuals. Three categories, namely internal migrants, external migrants and always resident individuals were created based on the migration history of the individual. Univariate and multivariate Cox regression models were used. Potential confounders such as age, socioeconomic status using number of assets as an index and level of education were controlled for in the multivariate model. Both univariate and multivariate Cox models were used to assess the risk of death separately for migrants compared to those always resident at the end of one year period, two years and finally at the end of the follow up period.

To assess the risk of dying from AIDS related complications among the various groups, a binary variable was generated that took the value 1 if an individual died from AIDS and 0 if not. Both univariate and multivariate logistic regression analyses were used to determine the odds of dying

from AIDS. The dependent variable was whether you died of AIDS or not, and the independent variables were age group, socioeconomic status, migration status and level of education. Significance level was set at 5%.

### 2.9 Ethical considerations

Ethical approval was obtained from the Human Research Ethics Committee of University of the Witwatersrand with Protocol Number M050928. Ethical clearance for the primary data collection by Africa Centre Demographic and Information System (ACDIS) was obtained from the University of Kwazulu Natal Nelson R. Mandela School Of Medicine. Prior to using the data from Africa Centre, a data user agreement was signed between the investigator and the Africa Centre for Population and Health.

# CHAPTER THREE: RESULTS

This chapter presents the results of the analysis for this study. The analyses are in two parts. One part of the analysis involves the estimation of the risk of death for recent migrants i.e. external in migrants and internal migrants compared to those always resident for the period 1st January 2001 to 31st December 2005. It also looked at the risk of death separately within a period of one year and a period of two years. The second part of the analysis looked at the risk of dying from AIDS related illnesses between migrants and non migrants. Cox proportional hazard regression and Kaplan Meier Survival estimates were conducted for the first part of the analysis and logistic regression was used for the second part.

## 3.1 Socio-demographic profile of the study sample

For the first part of the analysis, 41519 adults aged 18 to 60 years at last visit date with different recruitment or starting dates were followed up from 1st January 2001 to 31st December 2005. Out of this number, 24074 constituting 58.0% have always been resident in the area since 2001 till they either died or censored, i.e. they have either moved away from their households or were present during the last visit date by the field worker. Internal migrants or people who moved from a homestead to another within the Demographic Surveillance Area (DSA) till they either died or were censored were 5537 (13.3%). External in migrants or people who migrated from places outside the DSA into the surveillance area were 11907, constituting 28.7 % of the population aged 18 to 60 years. They were 18146 (43.7%) males and 23373 (56.3%) females. The median age of the participants was 28 years with an inter quartile range of 17 years. The median age of the external in migrants was 27 years with an inter quartile range of 12 years. Internal migrants had a median age of 27 years with inter quartile range of 14 years and those always resident had a median age of 29 with an inter quartile range of 22 years. The age distribution showed that the majority of the participants 17484 (42.1%) were in the age category 18 to 25, followed by those

age 26 to 40 years 14382 (34.6%) and the rest 9653 (23.3%) were aged 41 to 60 years. On education, 3382 (8.15%) have never been to school, 3408 (8.21%) had grade 0 to 4 education, 4827 (11.63%) had grade 5 to 7 education, 21906 (52.76%) had grade 8 to 12 education, 275 (0.66%) had tertiary level education, 2296 (5.53%) either refused or did not know their highest educational level achieved and 5425 (13.07%) had missing records. The maximum number of assets in a household was 23 with minimum 0. The mean number of assets was 6.97 with a standard deviation of 2.75. Table 1 gives the background characteristics of the participants included in the survival analysis:

**Table 1: Background characteristics of participants included in the survival analysis**

| Background Characteristics | Total n (%) | External n (%) | Internal n (%) | Resident n (%) | P-value |
|---|---|---|---|---|---|
| **Sex** | | | | | |
| Male | 18146 (43.7) | 5285 (29.1) | 2055 (11.3) | 10806 (59.6) | <0.001 |
| Female | 23373 (52.3) | 6622 (28.33) | 3482 (14.9) | 13269 (56.8) | |
| **Education** | | | | | |
| No Education | 3382 (8.2) | 581 (17.2) | 376 (11.1) | 2425 (71.7) | |
| Grade 0 to 4 | 3408 (8.2) | 719 (21.10) | 406 (11.9) | 2283 (67.0) | |
| Grade 5 to 7 | 4827 (11.6) | 1186 (24.6) | 657 (13.6) | 2984 (61.8) | |
| Grade 8 to 12 | 21906 (52.8) | 5963 (27.2) | 2770 (12.7) | 13173 (60.1) | <0.001 |
| Tertiary | 275 (0.7) | 31 (11.3) | 19 (6.9) | 225 (81.8) | |
| Don't know | 2296 (5.5) | 769 (33.5) | 359 (15.6) | 1168 (50.9) | |
| Missing | 5425 (13.1) | 2658 (49.0) | 950 (17.5) | 1817 (33.5) | |
| **Age category**: | | | | | |
| 18 to 30 | 23781 (57.3) | 7687 (32.3) | 3386 (14.2) | 12708 (53.4) | |
| 31 to 40 | 8085 (19.5) | 2479 (30.7) | 1196 (14.8) | 4410 (54.6) | <0.001 |
| 41 to 60 | 9653 (23.2) | 1741 (18.0) | 955 (9.9) | 6957 (72.1) | |
| **Economic status** | | | | | |
| < 7 household assets | 18736 (45.1) | 5153 (27.5) | 2833 (15.1) | 10750 (57.4) | |
| >= 7 household assets | 19744 (47.6) | 5829 (29.5) | 2073 (10.5) | 11842 (60.0) | <0.001 |
| Missing | 3039 (7.3) | 925 (30.4) | 631 (20.8) | 1483 (48.8) | |
| **Total** | 41519 | 11907 (28.7) | 5537 (13.3) | 24075 (58.0) | |

### 3.2 All cause mortality over five years of follow up from 2001 to 2005

The follow-up period from 1st January 2001 to 31st December 2005 yielded a total of 117012 person years and 2586 deaths with a mortality rate of 22.10 deaths per 1000 person years. Table 2 gives the relative risk of dying during the period.

**Table 2:** Relative risk (hazard ratio with 95% confidence intervals) for univariate and multivariate models for examining the survival experience of migrants and always resident individuals

| | | Univariate (unadjusted) | | | Multivariate analysis (adjusted) | | |
|---|---|---|---|---|---|---|---|
| Variable | n | Hazard Ratio | P-value | 95% CI | Hazard Ratio | P-value | 95% CI |
| **Sex of adult** | | | | | | | |
| * Females | 18146 | 1 | - | - | 1 | - | - |
| Male | 23373 | 1.24 | <0.001 | (1.15 , 1.34) | 1.38 | <0.001 | (1.28, 1.49) |
| **Migration status** | | | | | | | |
| External in migrant | 11907 | 1.52 | <0.001 | (1.38,1.68) | 1.19 | 0.001 | (1.08,1.32) |
| Internal migrant | 5537 | 0.98 | 0.815 | (0.85, 1.14) | 0.82 | 0.008 | (0.71, 0.95) |
| * Always resident | 24075 | 1 | - | - | 1 | - | - |
| **Education** | | | | | | | |
| * No Education | 3382 | 1 | - | - | 1 | - | - |
| Grade 0 to 4 | 3408 | 0.75 | <0.001 | (0.65, 0.88) | 0.81 | 0.007 | (0.69, 0.94) |
| Grade 5 to 7 | 4827 | 0.77 | <0.001 | (0.67, 0.89) | 0.95 | 0.475 | (0.82, 1.10) |
| Grade 8 to 12 | 21906 | 0.30 | <0.001 | (0.26, 0.33) | 0.50 | <0.001 | (0.44, 0.58) |
| Tertiary | 275 | 1.32 | 0.130 | (0.92, 1.88) | 1.40 | 0.071 | (0.97, 2.01) |
| Don't know | 2296 | 0.33 | <0.001 | (0.26, 0.43) | 0.37 | <0.001 | (0.29, 0.47) |
| Missing | 5425 | 3.34 | <0.001 | (2.95, 3.79) | 4.01 | <0.001 | (3.48, 4.62) |
| **Age category**: | | | | | | | |
| * 18 to 25 | 23781 | 1 | - | - | 1 | - | - |
| 26 to 40 | 8085 | 5.21 | <0.001 | (4.60, 5.90) | 4.09 | <0.001 | (3.60, 4.65) |
| 41 to 60 | 9653 | 4.66 | <0.001 | (4.10, 5.30) | 3.81 | <0.001 | (3.31, 4.37) |
| **Economic status** | | | | | | | |
| * >= 7 assets | 18736 | 1 | - | - | 1 | - | - |
| < 7 assets | 19744 | 1.27 | <0.001 | (1.17, 1.38) | 1.26 | <0.001 | (1.16, 1.38) |
| Missing | 3039 | 3.85 | <0.001 | (3.36, 4.10) | 1.18 | 0.025 | (102, 1.36) |

- Comparison group

External in migration i.e. movement of individuals into the surveillance area is associated with an increased risk of dying within the study period. A person who moved into the area is 1.52 times more likely to die compared to someone who was always resident since 2001, [unadjusted

HR=1.52, P<0.001 95% CI (1.38,1.68)]. After adjusting for the effects of sex, age group, socio-economic status and education in the multivariate model, an external in migrant has a relative risk of 1.19 of dying compared to those always resident, [adjusted HR=1.19, P=0.001, 95% CI (1.08,1.32)]

From the univariate model, an internal in migrant i.e. a person who has migrated from a homestead into another homestead within the surveillance area is 2% less likely to die compared to someone who is always resident. This however was not statistically significant, [unadjusted HR=0.98, P=0.815 95% CI ((0.85, 1.14)]. After controlling for the effects of other variables in the model, internal migrants are 18% less likely to die compared to always resident individuals. This was statistically significant [adjusted HR=0.82, P=0.008, 95% CI (0.71, 0.95)].

From the univariate and multivariate models, sex is significantly associated with death for adults aged 18 to 60 years in the surveillance area. The unadjusted relative risk shows that a male is 2.4 times more likely to die within the followed up period compared to a female, [unadjusted HR=1.24, P<0.001 95% CI (1.15, 1.34)]. After adjusting for the effects of migration status, age group, socio-economic status and level of education in the multivariate model, a male is 1.38 times more likely to die during the period than a female, [adjusted HR=1.38, P<0.001, 95% CI (1.28, 1.49)].

Individuals aged 26 to 40 and 41 to 60 years have higher risk of dying compared to those aged 18 to 25 even after adjusting for the effects of level of education, migration status, socio-economic status and sex.

On the effect of socio-economic status on mortality, individuals in households with less than seven assets were 1.26 times more likely to die compared to those with seven or more after adjusting for the effects of other variables in the multivariate Cox regression model, [adjusted HR= 1.26, P<0.001, 95% CI (1.16, 1.38)].

Those with grades 0 to 4 and 8 to 12 level of education had a significantly lower risk of dying compared to those with no education. Those with tertiary level education have a higher risk of dying compared to those with no education, but this was not statistically significant, [adjusted HR= 1.40, P=0.071, 95% CI (0.97, 2.01)]. Table 1 gives the details of the relative risks associated with the variables in the model.

### 3.3 Mortality experience during the first and second year of follow up:

Table 3 on the next page gives the relative risk of dying during the first and second year of follow-up.

**Table 3:** Risk of death during the first and second year of follow up:

| | One year follow up period | | Two years follow up period | |
|---|---|---|---|---|
| Variable | Unadjusted HR (95% CI) | Adjusted HR (95% CI) | Unadjusted HR (95% CI) | Adjusted HR (95% CI) |
| **Sex of adult** | | | | |
| * Females | 1 | - | 1 | - |
| Male | 1.29 (1.14 , 1.47) | 1.40 (1.23 , 1.59) | 1.26 (1.15, 1.40) | 1.37 (1.24, 1.52) |
| **Migration status** | | | | |
| External in migrant | 1.53 (1.33, 1.76) | 1.05 (0.91,1.22) | 1.59 (1.43, 1.78) | 1.22 (1.09,1.37) |
| Internal migrant | 0.76 (0.61, 0.97) | 0.56 (0.44, 0.71) | 0.94 (0.80, 1.12) | 0.75 (0.63, 0.90) |
| * Always resident | 1 | - | 1 | - |
| **Education** | | | | |
| * No Education | 1 | - | 1 | - |
| Grade 0 to 4 | 0.91 (0.67, 1.23) | 1.01 (0.75, 1.36) | 0.76 (0.62, 0.94) | 0.83 (0.67, 1.02) |
| Grade 5 to 7 | 0.98 (0.74, 1.28) | 1.30 (0.99, 1.72) | 0.77 (0.63, 0.93) | 0.96 (0.79, 1.17) |
| Grade 8 to 12 | 0.29 (0.23, 0.38) | 0.56 (0.43, 0.74) | 0.2 (0.23, 0.33) | 0.47 (0.39, 0.57) |
| Tertiary | 1.10 (0.54, 2.28) | 1.45 (0.70, 3.01) | 1.31 (0.84, 2.05) | 1.43 (0.91, 2.26) |
| Don't know | 0.20 (0.11, 0.37) | 0.25 (0.14, 0.46) | 0.15 (0.10, 0.24) | 0.18 (0.11, 0.28) |
| Missing | 4.13 (3.29, 5.18) | 6.63 (5.16, 8.53) | 3.12 (2.67, 3.66) | 3.88 (3.24, 4.64) |
| **Age category**: | | | | |
| * 18 to 25 | 1 | - | 1 | - |
| 26 to 40 | 5..70 (4.64, 7.01) | 4.50 (3.65, 5.55) | 5.12 (4.45, 6.06) | 4.03 (3.45, 4.72) |
| 41 to 60 | 4.82 (3.88, 6.00) | 4.50 (3.56, 5.67) | 4.43 (3.77, 5.22) | 3.74 (3.14, 4.46) |
| **Economic status** | | | | |
| * >= 7 assets | 1 | - | 1 | - |
| < 7 assets | 1.48 (1.28, 1.70) | 1.57 (1.38, 1.82) | 1.41 (1.26, 1.57) | 1.40 (1.25, 1.57) |
| Missing | 3.40 (2.78, 4.15) | 0.98 (0.80, 1.22) | 4.22 (3.63, 4.92) | 1.35 (1.14, 1.58) |

* Comparison group

Within one year of migrating in, the unadjusted hazard ratio for an external in migrant was 1.53, indicating that an external in migrant is 1.53 times more likely to die within one year of migrating into the surveillance area compared to those always resident and this was statistically significant

at 95% confidence level, [unadjusted HR= 1.53, P<0.001, 95% CI (1.33, 1.76)]. However, after adjusting for the effect of age group, sex, socio-economic status and educational level, it was no more statistically significant, [adjusted HR= 1.05, P=0.487, 95% CI (0.91, 1.22)]. When the duration of follow up is increased to two years, external in migrants were 1.59 times more likely to die compared to those always resident, [unadjusted HR= 1.59, P<0.001, 95% CI (1.43, 1.78)]. Even after adjusting for the effect of age group, socio-economic status, level of education and sex during the two years of follow up, external in migrants still had a significantly higher risk of death compared to those always resident, [adjusted HR= 1.22, P=0.001, 95% CI (1.09,1.37)]. In the univariate models, external in migrants had significantly higher risk of dying compared to those always resident during the first and second year of follow up. In the multivariate Cox regression models, external migrants still had a significantly higher risk of dying in the second year, but the risk was not significant during the first year after adjusting for the effect of the other variables in the model.

Migration within the surveillance area is associated with a decrease in risk of death. Within one year of migrating into a household, an internal migrant is 23% less likely to die compared to someone who is always resident, and this was statistically significant, [unadjusted HR= 0.77, P = 0.028, 95% CI (0.61, 0.97)]. After adjusting for the effect of other factors in the multivariate Cox regression model, internal migrants were 44% less likely to die within one year of migrating internally within the surveillance area, [adjusted HR= 0.56, P<0.001, 95% CI (0.44, 0.71)].

During two years of observation, internal migrants were 25% less likely to die compared to those always resident after adjusting for the effects of other variables in the model, [adjusted HR= 0.75, P=0.001, 95% CI (0.63, 0.90)].

Males were 1.40 times more likely to die compared to females during the first year of observation [adjusted HR = 1.40, P<0.001, 95% CI (1.23, 1.59)] and 1.34 times more likely to die within two years of follow up compared to females, [adjusted HR= 1.34, P<0.001, 95% CI (1.21, 1.48)]. Irrespective of the duration of observation, males generally have a significantly higher risk of dying compared to females.

Those with less than seven assets in their household were 1.57 times more likely to die during the first year of observation and 1.40 times during the second year compared to those with seven or more assets. The additional risk was statistically significant.

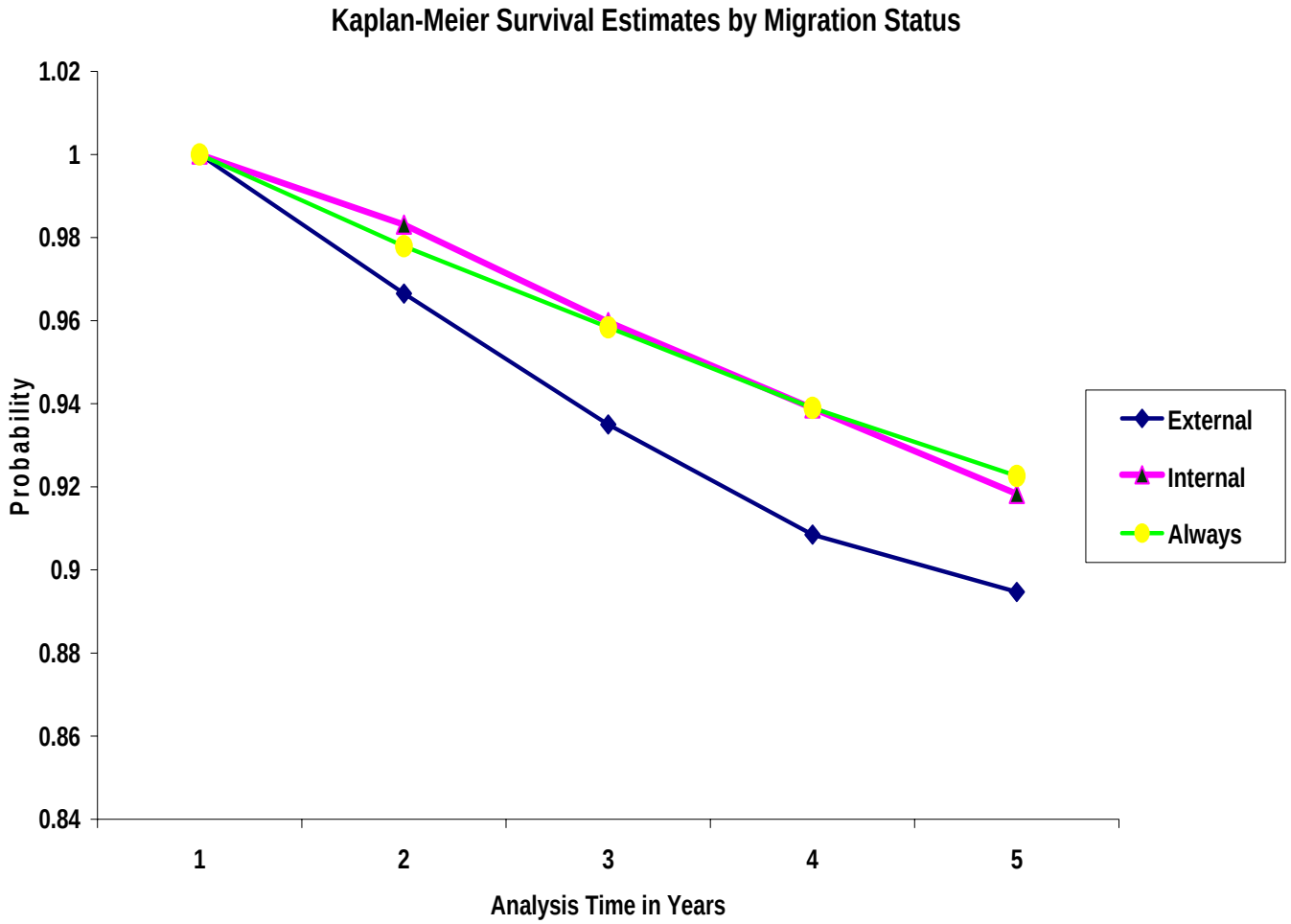
Individuals with grade 8 to 12 educational level had a significantly reduced risk of dying compared to those with no education during the first and the second year of follow up. Details can be found in Table 3.

### 3.4 Mortality rates among migrants and residents

In the first year of follow-up, a total of 921 deaths were recorded with a mortality rate of 24.6 per 1000 person years. In the second year, 1581 deaths were registered with a mortality rate of 24.0 per 1000 person years. External individual migrants had the highest mortality rates in the first, second and fifth year of follow-up. Table 4 on the next page summarizes the mortality rates at different times during the follow-up.

**Table 4:** Mortality experience of migrants and non migrants at specified periods

| Period | Number of deaths | Person years | Mortality rate per 1000 | 95% CI | |
|---|---|---|---|---|---|
| **1 year (over all)** | 921 | 37377.15 | 24.64 | 23.10 | 26.28 |
| **Sex** | | | | | |
| Females | 459 | 21008.36 | 21.85 | 19.9 | 23.94 |
| Males | 462 | 16368.79 | 28.22 | 25.76 | 30.92 |
| **Migration status** | | | | | |
| External in migrant | 328 | 9685.81 | 33.86 | 30.39 | 37.73 |
| Internal migrant | 80 | 4707.13 | 17.00 | 13.65 | 21.16 |
| Always resident | 513 | 22984.20 | 22.32 | 20.47 | 24.34 |
| **Age category**: | | | | | |
| 18 to 25 | 109 | 15605.27 | 6.98 | 5.79 | 8.43 |
| 26 to 40 | 506 | 12713.23 | 39.80 | 36.48 | 43.42 |
| 41 to 60 | 306 | 9058.64 | 33.78 | 30.20 | 37.78 |
| **2 years (over all)** | 1581 | 66024.27 | 23.95 | 22.79 | 25.16 |
| **Sex** | | | | | |
| Females | 798 | 37202.17 | 21.45 | 20.01 | 22.99 |
| Males | 783 | 28822.11 | 27.17 | 25.33 | 29.14 |
| **Migration status** | | | | | |
| External in migrant | 504 | 14924.90 | 33.77 | 30.95 | 36.85 |
| Internal migrant | 154 | 7677.15 | 20.06 | 17.13 | 23.49 |
| Always resident | 923 | 43422.22 | 21.26 | 19.93 | 22.67 |
| **Age category**: | | | | | |
| 18 to 25 | 199 | 27191.73 | 7.32 | 6.37 | 8.41 |
| 26 to 40 | 836 | 21980.23 | 38.03 | 35.54 | 40.70 |
| 41 to 60 | 546 | 16852.31 | 32.40 | 29.79 | 35.23 |
| **5 years (over all)** | 2586 | 117012.10 | 22.10 | 21.26 | 22.97 |
| **Sex** | | | | | |
| Females | 1334 | 66692.40 | 20.00 | 18.96 | 21.10 |
| Males | 1252 | 50319.70 | 24.88 | 23.54 | 26.30 |
| **Migration status** | | | | | |
| External in migrant | 598 | 18647.30 | 32.07 | 29.60 | 34.75 |
| Internal migrant | 210 | 10194.63 | 20.60 | 17.99 | 23.58 |
| Always resident | 1778 | 88170.18 | 20.17 | 19.25 | 21.13 |
| **Age category**: | | | | | |
| 18 to 25 | 309 | 46840.46 | 6.60 | 5.90 | 7.37 |
| 26 to 40 | 1272 | 36836.97 | 34.53 | 32.68 | 36.48 |
| 41 to 60 | 1005 | 33334.67 | 30.15 | 28.34 | 32.07 |




*Log rank test: P <0.0001*

Figure 1: Kaplan Meier Survival Estimates by migration status

From the Kaplan Meier survival estimates by migration status shown above, it is clear that external in migrants have the lowest survival rate during the period. From year one to three, internal migrants have a better survival rate than those always resident, but there was no difference in their survival rates from year three to four. From year four to five, those always resident seem to have a better survival rate than internal migrants.

### 3. 5 Causes of Death Results

For the deaths that occurred between 2001 and 2002 (n=1119), cause of death through verbal autopsy procedures were identified for all of them with 736 (65.8%) dying of AIDS. The mean age of the

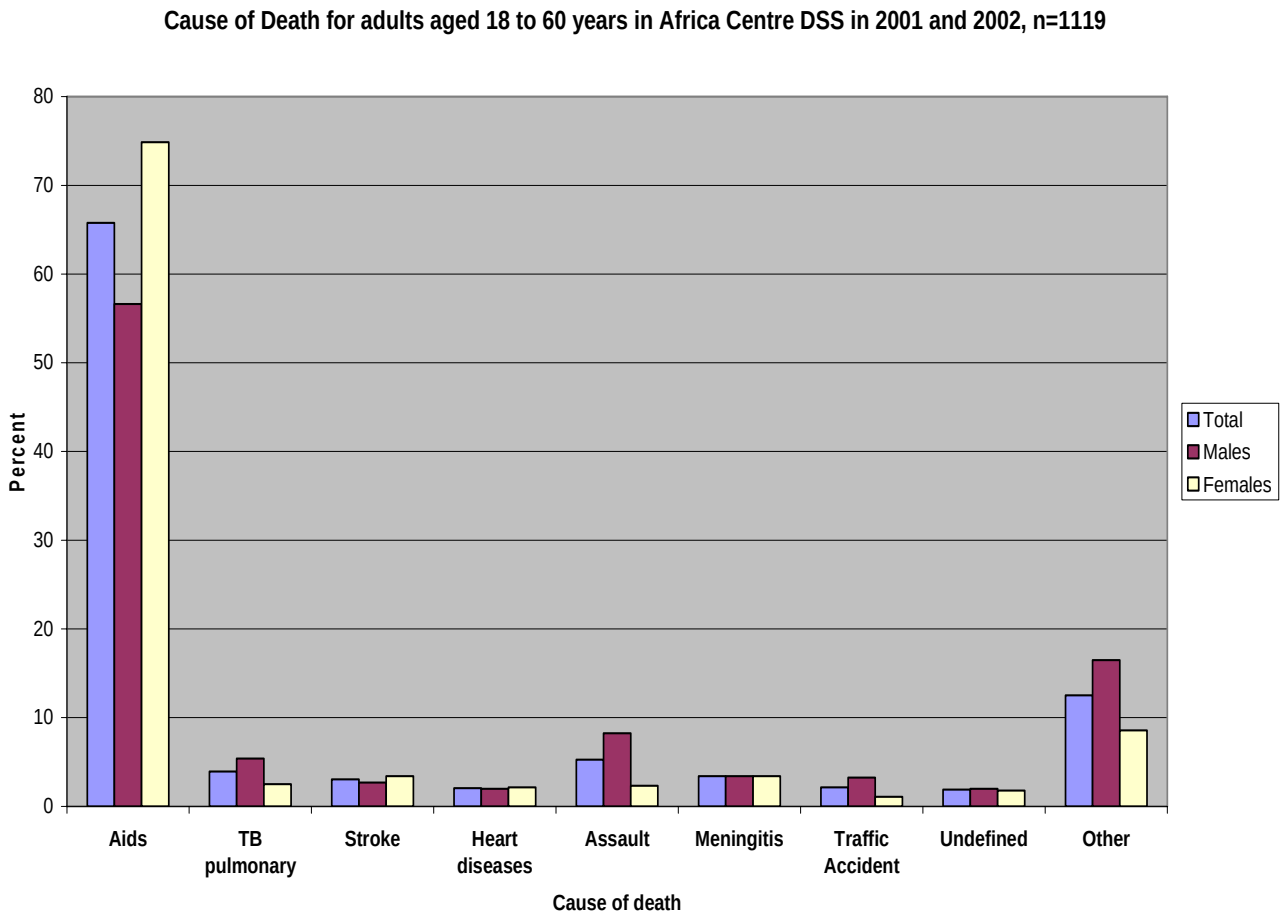
dead was 37.2 years with a standard deviation of 10.6 years. The mean age of the deceased external in-migrants was 33.5 years with a standard deviation of 8.3, the deceased internal migrants had a mean age of 33.4 years with a standard deviation 8.6 and those deceased who were always resident had a mean age of 38.0 with a standard deviation 10.7. Men were more likely to die of assault cases 46 (77.9%) than women 13 (22.0%). The majority of the deaths due to assault occurred in those always resident 52 (88.1%), external in migrants 5 (8.5%) and internal migrants 2 (3.4%). There were four suicide cases and all of whom were men. Table 5 gives the detail characteristics of the dead included in the cause of death analysis.

Table 5: **Characteristics of participants included in the cause of death analysis, n = 1119**

| Variable | Total no. (%) | AIDS deaths (%) | Other deaths (%) | P-value |
|---|---|---|---|---|
| **Sex of adult** | | | | |
| Male | 558 (49.9) | 316 (56.6) | 242 (43.4) | <0.001 |
| Female | 561 (50.1) | 420 (74.9) | 141 (25.1) | |
| **Migration status** | | | | |
| External in migrant | 148 (13.2) | 116 (78.4) | 32 (21.6) | |
| Internal migrant | 44 (3.9) | 32 (72.7) | 12 (27.3) | 0.001 |
| Always resident | 927 (82.8) | 588 (63.4) | 339 (36.6) | |
| **Education** | | | | |
| No Education | 158 (14.1) | 91 (57.6) | 67 (42.4) | |
| Grade 0 to 4 | 122 (10.9) | 76 (60.7) | 48 (39.3) | |
| Grade 5 to 7 | 139 (12.4) | 102 (73.4) | 37 (26.6) | |
| Grade 8 to 10 | 225 (20.1) | 152 (67.6) | 73 (32.4) | 0.014 |
| Tertiary | 19 (1.7) | 8 (42.1) | 11 (57.9) | |
| Missing | 456 (40.8) | 309 (67.7) | 147 (32.3) | |
| **Age category**: | | | | |
| 18 to 25 | 143 (12.8) | 81 (56.6) | 62 (43.4) | |
| 26 to 40 | 566 (50.6) | 433 (76.5) | 133 (23.5) | <0.001 |
| 41 to 60 | 410 (36.6) | 222 (54.1) | 188 (45.9) | |
| **Economic status** | | | | |
| < 7 household assets | 518 (46.3) | 352 (68.0) | 166 (32.0) | |
| >= 7 household assets | 398 (35.6) | 240 (60.3) | 158 (39.7) | 0.012 |
| Missing | 203 (18.1) | 144 (70.9) | 59 (29.1) | |
| **Total** | 1119 | 736 (65.8) | 383 (34.2) | - |

The chi square test for association between sex, migration status, highest educational attainment, age category, number of assets as a proxy for socio-economic status and AIDS as cause of death are all statistically significant from the p-values in table 5.

Figure 2:




### 3.5 AIDS mortality

Figure 3 summarizes the distribution of AIDS deaths by sex and migration status in 2001 and 2002. Of the 736 AIDS deaths, 57.1% of them were females and 42.9% males. External in migrants who died of HIV related causes were 116 (15.8%), 32 were internal migrants (4.3%) and 588 (79.9%) were always resident individuals. About 78.4% of all deaths among external in migrants were due to AIDS, 72.7% of internal migrant deaths were due to AIDS and 63.4%

always resident individuals died of AIDS. Fifty nine percent of AIDS deaths occurred in individuals aged 26 to 40 years, 81 (11.0%) of those aged 18 to 25 died of AIDS and the rest of the 222 (30.2%) AIDS deaths occurred to those aged 40 to 60. Those with less than seven assets in their households who died of AIDS were 352 (47.83%), 240 (32.61%) who died of AIDS had seven or more assets in their households and the remaining 144 (19.57%) had missing number of household assets, P=0.012.

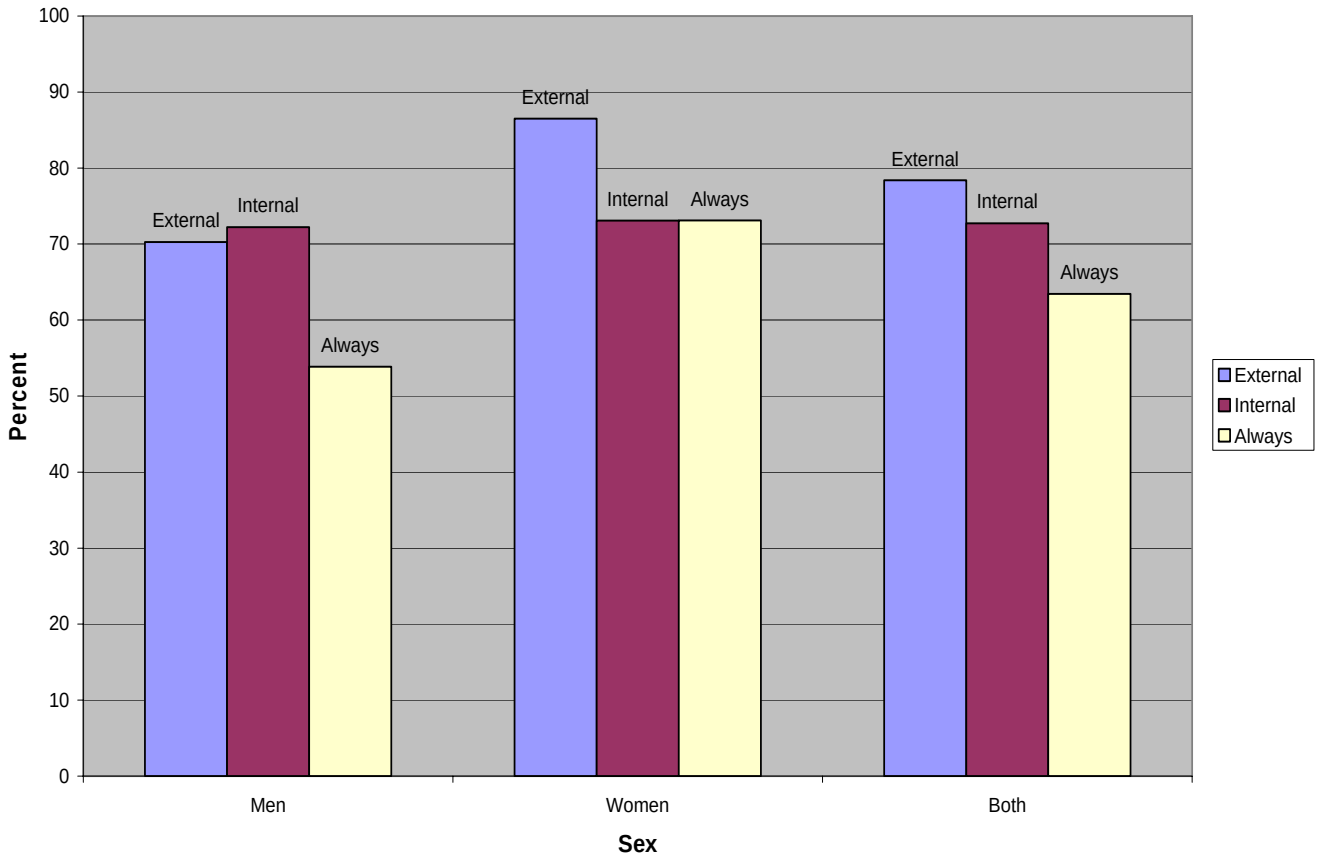



**Figure 3**: Percentage distribution of AIDS related deaths by migration status and sex in 2001 and 2002

The details of the estimated odds ratios and their confidence intervals for the factors associated with AIDS related deaths are described in Table 6.

**Table 6:** Odds ratio (OR) estimates and 95% confidence intervals for factors associate with AIDS deaths using univariate and multivariate models

| | Univariate (unadjusted) | | | Multivariate analysis (adjusted) | | |
|---|---|---|---|---|---|---|
| Variable | Odds Ratio | P-value | 95% CI | Odds Ratio | P-value | 95% CI |
| **Sex of adult** | | | | | | |
| *Males | 1 | - | - | 1 | - | - |
| Females | 2.28 | <0.001 | (1.77 , 2.94) | 2.33 | <0.001 | (1.78, 3.06) |
| **Migration status** | | | | | | |
| External in migrant | 2.09 | <0.001 | (1.38, 3.16) | 1.79 | 0.009 | (1.15,2.77) |
| Internal migrant | 1.54 | 0.213 | (0.78, 3.02) | 1.29 | 0.485 | (0.63, 2.61) |
| *Always resident | 1 | - | - | 1 | - | - |
| **Education** | | | | | | |
| * No Education | 1 | - | - | 1 | - | - |
| Grade 0 to 4 | 1.14 | 0.606 | (0.70, 1.84) | 0.98 | 0.936 | (0.59, 1.63) |
| Grade 5 to 7 | 2.03 | 0.005 | (1.23, 3.32) | 1.84 | 0.023 | (1.09, 3.10) |
| Grade 8 to 12 | 1.53 | 0.047 | (1.01, 2.34) | 1.25 | 0.346 | (0.78, 2.00) |
| Tertiary | 0.54 | 0.204 | (0.20, 1.40) | 0.33 | 0.037 | (0.12, 0.93) |
| Missing | 1.54 | 0.022 | (1.06, 2.24) | 1.19 | 0.400 | (0.79, 1.80) |
| **Age category**: | | | | | | |
| * 18 to 25 | 1 | - | - | 1 | - | - |
| 26 to 40 | 2.49 | <0.001 | (1.70, 3.66) | 3.24 | <0.001 | (2.15, 4.89) |
| 41 to 60 | 0.90 | 0.606 | (0.62, 1.33) | 1.29 | 0.243 | (0.84, 1.98) |
| **Economic status** | | | | | | |
| *>= 7 household assets | 1 | - | - | 1 | - | - |
| < 7 household assets | 1.40 | 0.017 | (1.06, 1.83) | 1.55 | 0.004 | (1.15, 2.09) |
| Missing | 1.61 | 0.011 | (1.12, 2.31) | 1.84 | 0.002 | (1.25, 2.72) |

From the univariate logistic model, the odds of a female dying from AIDS is 2.28 times compared to a male, [unadjusted odds ratio = 2.28, P<0.001, 95% CI (1.77, 2.94). After adjusting for the effect of age, socio-economic status, educational level and migration status, the odds of a female

dying from AIDS is 2.33 times compared to a male, [adjusted OR = 2.33, P<0.001, 95% CI (1.78, 3.06)]. The odds of dying from AIDS for adults aged 26 to 40 years was 2.49, [unadjusted OR = 2.49, P<0.001 with 95% CI (1.70, 3.66)] compared to those aged 18 to 25 years. Having adjusted for the effect of other variables, the odds of dying from AIDS for those aged 26 to 40 years was 3.24 compared to those in age group 18 to 25 and this was statistically significant at 95% confidence level [OR = 3.24, P<0.001, CI (2.15, 4.89)]. There was no significant difference in the risk of dying from AIDS for those aged 18 to 25 and those in the age category 26 to 40 years.

Individuals in households with less than seven assets had odds ratio of 1.40 (unadjusted) and 1.55 (adjusted) of dying from AIDS compared to those in households with seven or more assets. This was statistically significant at 5% significance level.

External in migrants have odds 2.09 times of dying from AIDS compared to those always resident and this was statistically significant at 95% confidence level [unadjusted OR = 2.09, P = 0.009 95% CI (1.38, 3.16)]. After adjusting for the effects of other variables in the multivariate logistic regression model, the odds of dying from AIDS as an external in migrant was 1.79 times, [OR = 1.79, P = 0.009, 95% CI (1.15, 2.77)] compared to those always resident and this was statistically significant. Even though internal migrants have a higher risk of dying from AIDS compared to those always resident, there were no significant differences in the risk of dying from AIDS between internal migrants and those always resident after adjusting for the effects of age, socio-economic status, age category and educational level, [OR = 1.29, P = 0.485, 95% CI (0.63, 2.61)].

## Chapter Four: Discussion

The high prevalence of HIV infection in Southern Africa, including South Africa, and the exceptionally high HIV prevalence reported among migrants, and coupled with the fact that AIDS is a terminal disease were some of the issues that prompted the writer to investigate the already existing phenomenon that people migrating into urban areas do return to their rural homes when they are severely ill to be treated and possibly to die[29]. With many studies confirming AIDS as the leading cause of death in South Africa, the study also aimed at finding out whether returning migrants to rural areas were more likely to die from AIDS related complications than those always resident.

This study has confirmed the hypotheses that returning migrants into rural areas are more likely to die compared to those always resident and that returning migrants into rural areas are more likely to die from AIDS compared to those always resident. It also provides evidence for the important role migration plays in influencing mortality levels in rural areas.

### 4.1 Mortality experience during the follow up period

Considering the follow up period of five years i.e. from 1st January 2001 to 31st December 2005, the results of the analysis indicate that being a recently returned migrant into the area is significantly associated with a higher risk of dying compared to those always resident. These findings are consistent with a similar study conducted in Agincourt DSS on circular labour migration and Mortality in Northeast South Africa where they found the annual odds of dying for recently returned migrants to be between 1.1 and 1.9 times higher than those of residents and long-term returned migrants[5]. Internal migrants from this current study have a significantly reduced risk of dying compared to always resident individuals after adjusting for the effect of other variables.

Within one year of follow up i.e. for a period of 365.25 days, external in migrants experience the highest mortality rate (34/1000 person years), followed by those always resident (22/1000 person years) and with internal migrants having the least mortality rate (17/1000 person years). The same mortality pattern was observed during the second year of follow up. The difference in the risk of death between external in migrants and those always resident during the first year of observation was statistically significant in the univariate model. However, after adjusting for the effect of other variables in the model, even though external in migrants still had a higher risk of dying than those always resident during the first year, this was no more statistically significant. Internal migrants in general have better survival chances than those always resident during the first year. In the two years of follow up, external migrants still had the highest risk of dying and internal migrants the lowest risk.

The study also found that despite the fact that women were more likely to die of AIDS than men, in general men were more likely to die during the period compared to women irrespective of the duration of follow up. The prevalence of HIV among women is generally higher than men[30,31]. The results of the first round of a Population-based Voluntary Counseling and Testing for HIV in the study area in 2004 showed a prevalence of HIV of 27.2% among women aged 15 to 49 years and 13.4% for men aged 15 to 54 years [31]. The high prevalence of HIV among women could be a contributing factor that could explain why women were more likely to die of AIDS compared to men. Other factors could be responsible for the observed differences in AIDS mortality between men and women which were not explored in this study. Further research is needed to determine some of the factors contributing to high AIDS mortality among females.

The number of assets in household used as a proxy for socio-economic status of the individual and age were associated with the risk of death in rural areas, with those in the age category of 26 to 40 years and those with low socio-economic status being more likely to die. People with Grade 8 to 12 level of education have the least risk of dying during the period of follow up. Even though those with tertiary education had a higher risk of death during the period than those with no education, this was not significant. The findings of this study suggest that people migrating into the study area were more likely to be sick and have a higher risk of dying compared to those resident and internal migrants.

People who migrate from rural to urban areas in search of jobs and other opportunities could be healthy and the movement could potentially be beneficial to them and members of their households. A study on the impact of rural-urban migration on child survival using Demographic and Health Surveys data from 17 different countries found that rural-urban migration probably improves child survival in most sub-Saharan Africa countries and that millions of children's lives may have been saved in the 1980s as a result of mothers moving to urban areas[32]. Migration of the productive youth to urban centres from rural areas thus seems to confer in the migrant youth and their households a lot of advantages. These advantages may be inherent in those persons who are prone to migrate[5]. However, there is a new twist to migration with those returning to rural areas being more likely to be sick. A study in Thailand to examine the extent of return migration of adults with AIDS found that there was a consistent pattern suggesting extensive return migration among persons with AIDS (PWAs) [15].

### 4.2 Migrants and AIDS mortality

The results of this study show that external in migrants i.e. people moving into the surveillance area were approximately two times more likely to die from AIDS compared to those resident. This

finding confirms the hypothesis that people migrating into rural areas were more likely to die from AIDS compared to non migrants. This is consistent with previous evidence of both high prevalence of HIV/AIDS among migrants and return migration taking place when the severity of illness experienced by persons with AIDS is substantial and the patients may need some social support from family members[15]. With the desire to die a good death being supported by family members and loved ones, severely ill AIDS patients may opt to return to rural areas where they could get this support despite the stigma that characterizes AIDS patients. Even though internal migrants were also more likely to die of AIDS compared to those always resident, this was not statistically significant in both the univariate and multivariate Cox proportional hazard regression models.

### 4.3 Other Factors Associated with AIDS Mortality

Even though being a male in the surveillance area is associated with a higher risk of death than a female during the follow up period, female adults were at least two times more likely to die from AIDS compared to male adults.

AIDS mortality is associated with age. The individuals aged 26 to 40 years were at least three times more likely to die from AIDS compared to those aged 18 to 25 years. These results to some degree are consistent with similar findings from a study to assess the mortality impact of HIV in rural Uganda were they found that the highest attributable risk of HIV associated deaths were observed in persons aged 20-39 years (PAF > 80%) and women [33]. This means that those aged 26 to 40 years were mostly affected by the HIV virus when they were still adolescents and the disease progressed to the advance stage during this interval. There was no significant difference in AIDS mortality between those age 18 to 25 and 41 to 60 years. AIDS is destroying the economically active population in this area when they are about to reach the peak of their lives,

and this group of people could potentially be the breadwinners in their households, and the consequences of losing such people in the community cannot be underestimated. The fact that the productive age group of 26 to 40 are more likely to die of AIDS poses a threat to rural communities in Africa and other developing countries with high prevalence of HIV.

Using number of household assets as an index for socio-economic status, individuals in households with less than seven assets were more likely to die of AIDS compared to those in households with seven or more assets. A study conducted to determine AIDS-related mortality rates and to describe factors associated with survival among a cohort of homosexual found that men with incomes over $10,000 at baseline had significantly longer survival from HIV to death compared to those with less after controlling for CD4 count and Zidovudine use (ZDV)[34]. Poverty could be playing a role in facilitating deaths due to AIDS in this area.

From this study, migration status, age, sex, socio-economic status and education are all associated with AIDS mortality in this study area. In Uganda, a study on AIDS mortality found sex, age, marital status, type of marriage, education, occupation, and ethnicity to be associated with Deaths, while the worst effect of AIDS deaths upon households was lack of finance[35].

### 4.4 Implications of findings

These findings have a lot of implications. In the first place, many rural areas in Sub-Saharan Africa lack adequate health facilities in their rural areas to cater for the increase disease burden associated with this phenomenon of migrants returning home to their rural areas when seriously ill. In South Africa and many other developing countries in Sub-Saharan Africa, health staff are already over burdened because of shortage of staff and increase in the number of patients reporting to various health institutions for treatment. The increase in disease burden in the health

institutions could partly be due to the AIDS epidemic, particularly in Southern Africa. The additional burden of caring for sick returning migrants will only make the situation worse for the rural areas that already lack basic health facilities and social infrastructure. The existing situation in the rural areas of many developing countries may speed up the death of these returning migrants. The mortality levels in rural areas would not be as high as we currently observe if not because of the influx of sick returning migrants into these areas. This trend has been exacerbated by the AIDS epidemic.

The findings of this study show that AIDS is becoming a greater threat in rural areas than in cities of the developing world. The threat comes from the fact that information and health services are less available in rural areas than in cities and cost of HIV/AIDS are largely borne by rural communities as HIV-infected urban dwellers of rural origin often return to their communities when they fall ill[28]. Rural areas are likely to be the hub or home to seriously sick AIDS patients and may have some implications for ART programmes being undertaken by governments in many countries in sub Saharan Africa. In South Africa, where government and other non governmental organizations are putting in so much effort to rollout ARVs to people leaving with HIV/AIDS, it is important to give priority attention to rural areas. The findings also add to a growing body of evidence that the sex of the individual, age, socio-economic status and level of education are associated with AIDS mortality.

### 4.5 Limitation

Possible bias that should be considered when interpreting these results includes selective enrolment or registration of individuals into residency in this area. It is possible that a returning migrant into the study area who died immediately after moving in will be considered by the household members as a resident member of the household compared to someone who moved into

the DSA and out migrated without dying. The probability also exists for returning migrants who died immediately after moving into the study area not to be registered as resident members of the homestead in the DSA where the sample for this study was drawn. If there is any selection bias or selective registration of individuals into residency, it is likely to affect both sides, i.e. both the dead and those who moved in and moved out without dying.

Another limitation of the study was the difficulty in establishing temporality of events on the socioeconomic status. The study could establish whether the deaths occurred before or after the household assets were acquired. The study did not have information on whether the household lost its assets as a result of the sickness and subsequent death of the member or not.

People do return to their hometowns or do go to certain rural areas for several reasons, which may not necessarily be due to ill health or terminal sickness, which could accidentally result in death shortly after they moved into those areas. This study could not ascertain the health conditions of the migrants when they moved into the surveillance area. Another limitation of the study is the use of verbal autopsy to determine the probable cause of death. Even though a number of studies have found this instrument to have a high sensitivity and specificity and can reasonably determine most causes of deaths[36, 37], it is not the gold standard in determining causes of death. There is a possibility of potential misclassification of AIDS deaths by verbal autopsy procedures in this study. A validation of the ACDIS verbal autopsy data against hospital records in the study area in 2000 found the sensitivity, specificity and positive predictive value of the verbal autopsies for non AIDS deaths of over 90%[2]. For AIDS deaths, it was found that the sensitivity, specificity and positive predictive value were 80, 82 and 85% respectively[2].

## Chapter Five: Conclusion and Recommendation

This study leads to the conclusion that internal migrants were less likely to die compared to those always resident, and those migrating into the study area were more likely to more likely to die compared to the always resident individuals. Even though, men were more likely to die during the study period compared to women, in general women were more likely to die from AIDS compared to men. Low socioeconomic status is associated with an increased risk of dying from all causes as well as from AIDS. Individuals aged 26 to 40 years have the highest adult mortality rate in the area among the adults aged 18 to 60 years and are also more likely to die from AIDS. External in migrants were more likely to die from AIDS compared to those always resident. There was no significant difference in the risk of dying from AIDS between internal migrants and those always resident.

Rural areas, particular in sub-Saharan Africa, are going to be the worst affected areas by the AIDS epidemic. This is not only because of the already increasing prevalence of HIV in these areas, but also as a result of the influx of sick returning migrants to the these areas. The returning migrants are sometimes the breadwinners, and if these people are the ones more likely to contract HIV/AIDS and to die, the consequences of this phenomenon to their families cannot be underestimated.

Interventions aimed at or targeting returning migrants and those resident in the rural areas may well be needed, and this is further justified by the findings that returning migrants are more at risk of dying compared to those always resident.

A significant structural short to long term intervention is that of encouraging rural development. This has the potential to alter conditions that force large numbers of young men and women to

seek temporary employment in urban areas. These kinds of interventions are needed in many rural parts sub-Saharan Africa, where large scale population movement is the norm.

There is the need for governments and other non governmental organization to come out with policies and programmes to better the conditions of the people in the rural areas as well as the returning migrants. There is the need for ARVs rollout to be intensified in rural areas as seriously sick AIDS patients are likely to be found in these areas. In resource-poor settings, especially in many parts of sub-Saharan Africa and other developing countries with very high prevalence of HIV/AIDS and over burdened health services in rural areas, it is important to identify and quantify some of these trends contributing to high disease burdens and mortality in rural areas in order to put in place effective interventions to better the health conditions of the people in these areas.

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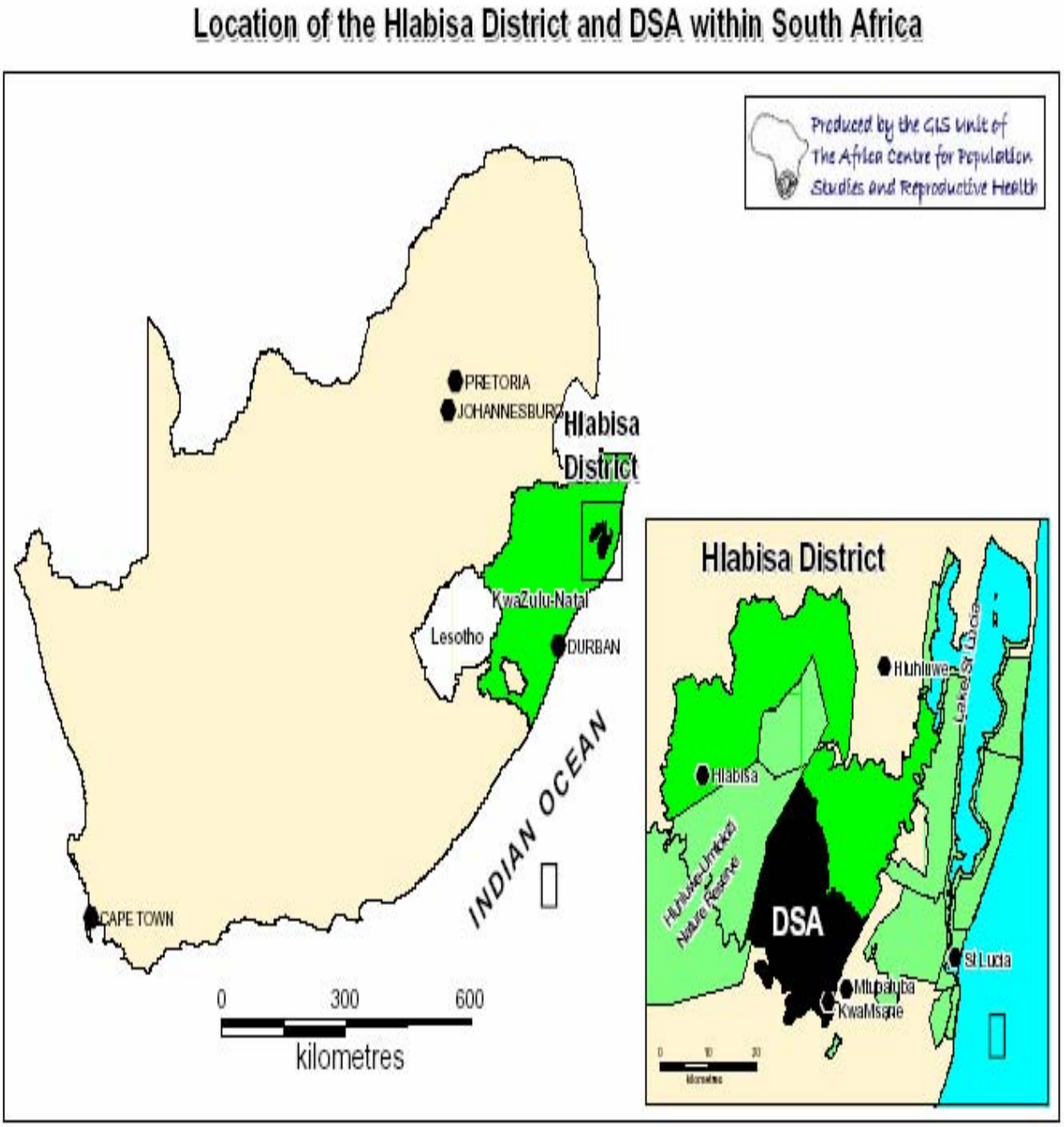
Appendix 1


Location of the Hlabisa District and DSA within South Africa
Produced by the GIS Unit of
The Africa Centre for Population
Studies and Reproductive Health
PRETORIA
JOHANNESBURG
Hlabisa
District
KwaZulu-Natal
Lesotho
DURBAN
INDIAN OCEAN
CAPE TOWN
0
300
600
kilometres
Hlabisa District
Hluhluwe
Lake St Lucia
Hlabisa
Hluhluwe-Umfolozi
Nature Reserve
DSA
St Lucia
Mtubatuba
KwaMsane

Appendix 2

**UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG**

Division of the Deputy Registrar (Research)

**HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)**
R14/49 Welaga

| | |
|---|---|
| **CLEARANCE CERTIFICATE** | **PROTOCOL NUMBER M050928** |
| **PROJECT** | The Impact of Migration on Adult Mortality in Rural SA: Do People Migrate into Rural Areas to Die? |
| **INVESTIGATORS** | Mr P Welaga |
| **DEPARTMENT** | School of Public Health |
| **DATE CONSIDERED** | 05.09.30 |
| **DECISION OF THE COMMITTEE*** | Approved unconditionally |

**Unless otherwise specified this ethical clearance is valid for 5 years and may be renewed upon application.**

**DATE** 05.10.25 **CHAIRPERSON** .....
(Professor PE Cleaton-Jones)

*Guidelines for written 'informed consent' attached where applicable

cc: Supervisor : Dr R Weiner

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**DECLARATION OF INVESTIGATOR(S)**

To be completed in duplicate and **ONE COPY** returned to the Secretary at Room 10005, 10th Floor, Senate House, University.
I/We fully understand the conditions under which I am/we are authorized to carry out the abovementioned research and I/we guarantee to ensure compliance with these conditions. Should any departure to be contemplated from the research procedure as approved I/we undertake to resubmit the protocol to the Committee. **I agree to a completion of a yearly progress report.**

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES

UNIVERSITY OF
KWAZULU-NATAL
Nelson R Mandela School of Medicine

8 June 2004

*Professor A J Herbst*
Africa Centre
Fax : 035 550 7565

Dear Professor Herbst

**PROTOCOL**: A socio demographic platform for population-based reproductive health research in a rural health district of KwaZulu-Natal. (GC Solarsh, Paediatrics) A J Herbst, Africa Centre. Ref **E009/00**

I wish to confirm that the decision of the sub-Committee of the Research Ethics Committee to approve Amendment dated 20 April 2004 was ratified at a full sitting of the Committee when it met on 8 June 2004.

Yours sincerely

Cheryl Borresen
Medical Research Administration